

# EXHIBIT A



## Kevin W. Bowyer

**Schubmehl-Prein Professor**

**Department Chair**

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Professor Bowyer serves as Chair of the Department of Computer Science and Engineering, a position he has held since 2001. He has led the Department through substantial growth in external funding, size of the PhD program, and number of faculty. He has also nurtured new cross-disciplinary research collaborations between faculty in CSE and faculty in Biology, Psychology and Physics, as well as with other departments in Engineering. The Department's undergraduate programs in Computer Engineering and in Computer Science have been enhanced through the introduction of new Concentration options, including in Bioinformatics and Computational Biology, offered in collaboration with the Department of Biological Sciences, in Media Computing, offered in collaboration with the Department of Art and Design, in Cyber Security and in Cloud Computing.

Professor Bowyer received a 2014 IEEE Computer Society Technical Achievement Award, with the citation *for pioneering contributions to the science and engineering of biometrics*. Professor Bowyer is serving as General Chair for the *IEEE International Conference on Face and Gesture Recognition*, to be held in May of 2015, and as General Chair of the *IEEE International Conference on Biometrics Theory, Applications and Systems*, to be held in September of 2015. Professor Bowyer is currently an Associate Editor for *IEEE Access*, IEEE's first open access mega journal.

Professor Bowyer has served as Editor-In-Chief of the *IEEE Transactions on Pattern Analysis and Machine Intelligence*, broadly acknowledged as the premier journal in its areas of coverage, and as the inaugural Editor-In-Chief of the *IEEE Biometrics Compendium*, the IEEE's first "virtual journal". He previously served as General Chair of the 2011 *IEEE International Joint Conference on Biometrics* and as Program Chair of the 2011 *IEEE International Conference on Automated Face and Gesture Recognition*, and was founding General Chair of the *IEEE International Conference on Biometrics Theory, Applications and Systems (BTAS)* conference series, serving as General Chair in 2007, 2008 and 2009. He has also contributed intellectual and technical support for a number of government-sponsored "challenge programs" in biometrics, including the

Face Recognition Grand Challenge, the Iris Challenge Evaluation, the Face Recognition Vendor Test and the Multiple Biometrics Grand Challenge. His paper "Face Recognition Technology: Security Versus Privacy," published in *IEEE Technology and Society*, was recognized with an Award of Excellence from the Society for Technical Communication. Professor Bowyer has also been active in data mining research, especially the development of classifier ensemble techniques for problems that exhibit "extreme" characteristics, such as a high imbalance between classes, unusually large training data, or noise in the class labels.

Professor Bowyer won three teaching awards while on the faculty at the University of South Florida. He also received a Distinguished Faculty Award for his mentoring work with under-represented students in the University of South Florida McNair Scholars Program.

Professor Bowyer earned his PhD in Computer Science from Duke University. While at Duke, he developed algorithms for estimating shunted blood flow in the heart, and for CT stereotaxis calculations used by neurosurgeons operating on the brain.

## PROFESSIONAL EXPERIENCE

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2001-	Schubmehl-Prein Professor and Department Chair Department of Computer Science & Engineering
2002-	Concurrent Professor of Electrical Engineering University of Notre Dame
1994-2001	Professor, Department of Computer Science & Engineering
1998-2001	Courtesy Professor of Cognitive Neural Sciences, Department of Psychology
1989-1994	Associate Professor, Department of Computer Science & Engineering
1984-1989	Assistant Professor, Department of Computer Science & Engineering University of South Florida
1997	Visiting Professor, Center for Automation Research, University of Maryland
1991	Visiting Associate Professor, Electrical Engineering, Univ. of Washington
1998, 1990	Summer Faculty Research Fellow, Oak Ridge National Lab, 1998, 1990
1987	UES Summer Research Fellow, Rome Air Development Center
1985	UES Summer Research Fellow, Mathematics Laboratory, Eglin AFB
1983-1984	Research Faculty, Informatics Institute, Swiss Federal Technical Institute
1980-1983	Research Assistant Professor Department of Computer Science, Duke University.

## DEGREES

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Ph.D., Duke University, 1980.

B.S., George Mason University, 1976.

## HONORS AND AWARDS

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- IEEE Computer Society Technical Achievement Award, 2014
- IAPR Fellow, 2012
- IEEE Biometrics Council Distinguished Lecturer, 2011-2012
- Award of Excellence, Society for Technical Communication, Philadelphia Chapter, 2005; for the paper "Face Recognition Technology: Security Versus Privacy," published in *IEEE Technology and Society Magazine*, spring 2004.
- Golden Core Member, IEEE Computer Society, 2002
- Certificate of Appreciation, IEEE Computer Society, 1999, *for dedicated service to the Computer Society Fellow Selection Committee*
- IEEE Fellow (Computer Society), 1998, *for contributions to algorithms for recognizing objects in images*
- Teaching Incentive Program Award, USF College of Engineering, 1997
- IEEE Computer Society Distinguished Visitors Program lecturer, 1996-1999
- Teaching Incentive Program Award, USF College of Engineering, 1994
- Distinguished Faculty Award, USF McNair Scholars Program, 1992-1994
- Outstanding Undergraduate Teaching Award, USF College of Engineering, 1991

## JOURNAL EDITORIAL SERVICE

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- EIC, *IEEE Biometrics Compendium*, 2010-2012
- EIC, *IEEE Transactions on Pattern Analysis and Machine Intelligence*, 1999-2000
- North American Editor, *Image and Vision Computing Journal*, 1994-1998, 2003-2006
- Editorial Board, *IEEE Access*, 2014-
- Editorial Board, *IET Biometrics*, 2012-
- Associate Editor, *IEEE Transactions on Pattern Analysis and Machine Intelligence*, 1995-1998
- Area Editor, *Computer Vision and Image Understanding*
- Editorial Board, *Machine Vision and Applications*
- Editorial Board, *International Journal of Pattern Recognition and Artificial Intelligence*
- Editorial Board, *Journal of Privacy Technology*
- Advisory Board, *Electronic Letters in Computer Vision and Image Analysis*
- Associate Editor, *Identity in the Information Society*

## **PUBLICATIONS – PEER-REVIEW JOURNAL**

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Jeremiah R. Barr, Kevin W. Bowyer and Patrick J. Flynn, Framework for Active Clustering with Ensembles, *IEEE Transactions on Information Forensics and Security*, to appear.

Kevin W. Bowyer and James S. Doyle, Cosmetic Contact Lenses and Iris Recognition Spoofing, *IEEE Computer* 47 (5), 96-98, May 2014.

<http://dx.doi.org/10.1109/MC.2014.118>

Daksha Yadav, Naman Kohli, James S. Doyle, Richa Singh, Mayank Vatsa and Kevin W. Bowyer, Unraveling the Effect of Textured Contact Lenses on Iris Recognition, *IEEE Transactions on Information Forensics and Security* 9 (5), 851-862, May 2014.

<http://dx.doi.org/10.1109/TIFS.2014.2313025>

Jim Thomas, Ahsan Kareem and Kevin W. Bowyer, Automated post-storm damage classification of low-rise building roofing systems using high resolution aerial imagery, *IEEE Transactions on Geoscience and Remote Sensing* 52 (7), 3851-3861, July 2014.

<http://dx.doi.org/10.1109/TGRS.2013.2277092>

Jeffrey R. Paone, Patrick J. Flynn, P. Jonathon Philips, Kevin W. Bowyer, Richard W. Vorder Bruegge, Patrick J. Grother, George W. Quinn, Matthew T. Pruitt and Jason M. Grant, Double Trouble: Differentiating Identical Twins by Face Recognition, *IEEE Transactions in Information Forensics and Security* 9 (2), 285-295, February 2014.

<http://dx.doi.org/10.1109/TIFS.2013.2296373>

Soma Biswas, Gaurav Aggarwal, Kevin W. Bowyer and Patrick J. Flynn, Pose-Robust Recognition of Low-Resolution Face Images, *IEEE Transactions on Pattern Analysis and Machine Intelligence* 35 (12), 3037-3049, December 2013.

<http://dx.doi.org/10.1109/TPAMI.2013.68>

Samuel P. Fenker, Estefan Ortiz, and Kevin W. Bowyer, Template Aging Phenomenon in Iris Recognition, *IEEE Access* 1, 266-274, 2013.

<http://dx.doi.org/10.1109/ACCESS.2013.2262916>

Soma Biswas, Kevin W. Bowyer and Patrick J. Flynn, Multidimensional Scaling for Matching Low-resolution Face Images, *IEEE Transactions on Pattern Analysis and Machine Intelligence*, 34 (10), 2019-2030, October 2012.

<http://doi.ieeecomputersociety.org/10.1109/TPAMI.2011.278>

Jeremiah Barr, Kevin W. Bowyer, Patrick Flynn and Soma Biswas, Face Recognition from Video: A Review, *International Journal of Pattern Recognition and Artificial Intelligence* 26 (5), August 2012. <http://dx.doi.org/10.1142/S0218001412660024>

Ryan Connaughton, Amanda Sgroi, Kevin W. Bowyer and Patrick Flynn, A Multi-Algorithm Analysis of Three Iris Biometric Sensors, *IEEE Transactions on Information Forensics and Security* 7 (3), 919-931, June 2012.

<http://dx.doi.org/10.1109/TIFS.2012.2190575>

Kevin W. Bowyer, The Results of the NICE.II Iris Biometrics Competition, *Pattern Recognition Letters* 33 (8), 965-969, June 2012.

<http://dx.doi.org/10.1016/j.patrec.2011.11.024>

Karen Hollingsworth, Shelby S. Darnell, Philip E. Miller, Damon L. Woodard, Kevin W. Bowyer, and Patrick J. Flynn, Human and Machine Performance on Periocular Biometrics Under Near-Infrared Light and Visible Light, *IEEE Transactions on Information Forensics and Security* 7 (2), April 2012.

<http://dx.doi.org/10.1109/TIFS.2011.2173932>

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Karen Hollingsworth, Kevin W. Bowyer and Patrick J. Flynn. Improved Iris Recognition Through Fusion of Hamming Distance and Fragile Bit Distance, *IEEE Transactions on Pattern Analysis and Machine Intelligence* 33 (12), 2465-2476, December 2011.

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Karen Hollingsworth, Kevin W. Bowyer, Stephen Lagree, Samuel P. Fenker and Patrick J. Flynn, Genetically Identical Irises Have Texture Similarity That Is Not Detected By Iris Biometrics, *Computer Vision and Image Understanding*, 115 (2011), 1493-1502.

<http://dx.doi.org/10.1016/j.cviu.2011.06.010>

Kevin W. Bowyer, What Surprises Do Identical Twins Have for Identity Science?, *IEEE Computer* 44 (7), July 2011, 100-102.

<http://dx.doi.org/10.1109/MC.2011.221>

Larry Shoemaker, Robert E. Banfield, Lawrence O. Hall, Kevin W. Bowyer and W. Philip Kegelmeyer. Detecting and ordering salient regions, *Data Mining and Knowledge Discovery* 22 (1-2) 259-290, 2011. <http://dx.doi.org/10.1007/s10618-010-0194-6>

Sarah Baker, Amanda Hentz, Kevin W. Bowyer and Patrick J. Flynn. Degradation of iris recognition performance due to non-cosmetic prescription contact lenses, *Computer Vision and Image Understanding*, 14 (9), 1030-1044, September 2010. <http://dx.doi.org/10.1016/j.cviu.2010.06.002>

P. Jonathon Phillips, W. Todd Scruggs, Alice J. O'Toole, Patrick J. Flynn, Kevin W. Bowyer, Cathy L. Schott, and Matthew Sharpe. FRVT 2006 and ICE 2006 large-scale experimental results, *IEEE Transactions on Pattern Analysis and Machine Intelligence* 32 (5), May 2010, 831-846. <http://dx.doi.org/10.1109/TPAMI.2009.59>

Kevin W. Bowyer, Sarah E. Baker, Amanda Hentz, Karen Hollingsworth, Tanya Peters and Patrick J. Flynn. Factors that degrade the match distribution in iris biometrics, *Identity in the Information Society* 2 (3), December 2009.

<http://dx.doi.org/10.1007/s12394-009-0037-z>

Karen Hollingsworth, Tanya Peters, Kevin W. Bowyer and Patrick J. Flynn. Iris recognition using signal-level fusion of frames from video, *IEEE Transactions on Information Forensics and Security* 4 (4), 837-848, December 2009.



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Karen Hollingsworth, Kevin W. Bowyer and Patrick J. Flynn. The best bits in an iris code, *IEEE Transactions on Pattern Analysis and Machine Intelligence* 31 (6), 964-973, June 2009. <http://dx.doi.org/10.1109/TPAMI.2008.185>

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Timothy C. Faltemier, Kevin W. Bowyer and Patrick J. Flynn. Using a multi-instance enrollment representation to improve 3D face recognition, *Computer Vision and Image Understanding* 112 (2008), 114-125. <http://dx.doi.org/10.1016/j.cviu.2008.01.004>

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Larry Shoemaker, Robert E. Banfield, Lawrence O. Hall, Kevin W. Bowyer and W. Philip Kegelmeyer. Using classifier ensembles to label spatially disjoint data, *Information Fusion* 9 (1), 120-133, January 2008. <http://dx.doi.org/10.1016/j.inffus.2007.08.001>

P. Jonathon Phillips, Kevin W. Bowyer and Patrick J. Flynn. Comment on the CASIA version 1.0 iris dataset, *IEEE Transactions on Pattern Analysis and Machine Intelligence* 29 (10), 1869-1870, Oct. 2007. <http://dx.doi.org/10.1109/TPAMI.2007.1137>

Ping Yan and Kevin W. Bowyer. A fast algorithm for ICP-based 3D shape biometrics, *Computer Vision and Image Understanding* Volume 107 (3), 195-202, September 2007. <http://dx.doi.org/10.1016/j.cviu.2006.11.001>

Ping Yan and Kevin W. Bowyer. Biometric recognition using three-dimensional ear shape, *IEEE Transactions on Pattern Analysis and Machine Intelligence* 29 (8), 1297-1308, August 2007. <http://dx.doi.org/10.1109/TPAMI.2007.1067>

Robert E. Banfield, Lawrence O. Hall, Kevin W. Bowyer and W. Philip Kegelmeyer. A comparison of decision tree ensemble creation techniques, *IEEE Transactions on Pattern Analysis and Machine Intelligence* 29 (1), 173-180, January 2007. <http://dx.doi.org/10.1109/TPAMI.2007.2>

Kevin W. Bowyer, Kyong I. Chang, Patrick J. Flynn, and Xin Chen. Face recognition using 2D, 3D and infra-red: Is multi-modal better than multi-sample?, *Proceedings of the IEEE* 94 (11), 2000-2012, Nov. 2006. <http://dx.doi.org/10.1109/JPROC.2006.885134>

Kyong I. Chang, Kevin W. Bowyer and Patrick J. Flynn. Multiple nose region matching for 3D face recognition under varying facial expression, *IEEE Transactions on Pattern Analysis and Machine Intelligence*, 28 (10), 1695-1700, October 2006. <http://dx.doi.org/10.1109/TPAMI.2006.210>

Kevin W. Bowyer, Kyong I. Chang, and Patrick J. Flynn. A survey of approaches and challenges in 3D and multi-modal 3D+2D face recognition, *Computer Vision and Image Understanding*, 101 (1), 1-15, Jan. 2006. <http://dx.doi.org/10.1016/j.cviu.2005.05.005>

The above article was number one on the *CVIU* "Top 25" list for October – December of 2005 and January – March of 2006, and in the top eight most-downloaded for five straight quarters.

Xin Chen, Patrick J. Flynn and Kevin W. Bowyer. Infra-red and visible-light face recognition, *Computer Vision and Image Understanding*, 99 (3), 332-358, September 2005. <http://dx.doi.org/10.1016/j.cviu.2005.03.001>

The above article was number two on the *CVIU* "Top 25" list for July – September of 2005, and number nine for October – December 2005.

Kyong I. Chang, Kevin W. Bowyer, and Patrick J. Flynn. An evaluation of multi-modal 2D+3D face biometrics, *IEEE Transactions on Pattern Analysis and Machine Intelligence* 27 (4), 619-624, April 2005. <http://dx.doi.org/10.1109/TPAMI.2005.70>

Robert E. Banfield, Lawrence O. Hall, Kevin W. Bowyer, and W. Philip Kegelmeyer. Ensemble diversity measures and their application to thinning, *Information Fusion* 6 (1), 49-62, March 2005. <http://dx.doi.org/10.1016/j.inffus.2004.04.005>

Sudeep Sarkar, P. Jonathon Phillips, Zongyi Liu, Isidro Robledo, Patrick Grother, and Kevin W. Bowyer. The Human ID Gait Challenge Problem: data sets, performance, and analysis, *IEEE Transactions on Pattern Analysis and Machine Intelligence* 27 (2), February 2005, 162-177. <http://dx.doi.org/10.1109/TPAMI.2005.39>

Jaesik Min and Kevin W. Bowyer. Improved range image segmentation by analyzing surface fit patterns, *Computer Vision and Image Understanding* 97 (2), 242-258, February 2005. <http://dx.doi.org/10.1016/j.cviu.2004.06.003>

Xiaomei Liu, Lawrence O. Hall, and Kevin W. Bowyer. Comments on "A Parallel Mixture of SVMs for Very Large Scale Problems," *Neural Computation* 16 (7), 1345-1351, July 2004. <http://dx.doi.org/10.1162/089976604323057416>

Nitesh Chawla, Lawrence O. Hall, Kevin W. Bowyer and W. Philip Kegelmeyer. Learning ensembles from bites: a scalable and accurate approach, *Journal of Machine Learning Research* 5, 421-451, April 2004. <http://jmlr.csail.mit.edu/papers/v5/>

Kevin W. Bowyer. Face recognition technology and the security versus privacy tradeoff, *IEEE Technology and Society*, 9-20, Spring 2004. <http://dx.doi.org/10.1109/MTAS.2004.1273467>

The above article received a 2005 *Award of Excellence* from the Society for Technical Communication, Philadelphia chapter.

Jaesik Min, Mark Powell, and Kevin W. Bowyer. Automated performance evaluation of range image segmentation algorithms, *IEEE Transactions on Systems, Man, and Cybernetics - Part B* 34 (1), 263-271, February 2004.



<http://dx.doi.org/10.1109/TSMCB.2003.811118>

Kyong Chang, Kevin W. Bowyer, Sudeep Sarkar, and Barnabas Victor. Comparison and combination of ear and face Images for appearance-based biometrics, *IEEE Transactions on Pattern Analysis and Machine Intelligence* 25 (9), 1160-1165, September 2003. <http://dx.doi.org/10.1109/TPAMI.2003.1227990>

Lawrence O. Hall, Kevin W. Bowyer, Robert E. Banfield, Steven Eschrich and Richard Collins. Is Error-Based Pruning Redeemable? *International Journal on Artificial Intelligence Tools* 12 (3), 249-264, September 2003. <http://dx.doi.org/10.1142/S0218213003001228>

Adam W. Hoover, Dmitry B. Goldgof and Kevin W. Bowyer. Egomotion estimation of a range camera using the space envelope, *IEEE Transactions on Systems, Man, and Cybernetics – Part B* 33 (4), 717-721, August 2003. <http://dx.doi.org/10.1109/TSMCB.2003.814297>

Nitesh V. Chawla, Thomas E. Moore, Lawrence O. Hall, Kevin W. Bowyer, W. Philip Kegelmeyer, and Clayton Springer. Distributed learning with bagging-like performance, *Pattern Recognition Letters* 24 (1-3), 455-471, 2003. [http://dx.doi.org/10.1016/S0167-8655\(02\)00269-6](http://dx.doi.org/10.1016/S0167-8655(02)00269-6)

Nitesh Chawla, Kevin W. Bowyer, Lawrence O. Hall, and W. Philip Kegelmeyer. SMOTE: Synthetic Minority Over-sampling TEchnique, *Journal of Artificial Intelligence Research* 16, 321-357, 2002. <http://dx.doi.org/10.1613/jair.953>

Kevin W. Bowyer. “Star Wars” revisited – A continuing case study in ethics and safety-critical software, *IEEE Technology and Society* 21 (1), 13-26, Spring 2002. <http://dx.doi.org/10.1109/44.993597>

The above article is listed in [Guide to Technology and Society Magazine Articles Relating to ABET or CSAB Accreditation Requirements](#).

Min C. Shin, Dmitry B. Goldgof, and Kevin W. Bowyer. Comparison of edge detector performance through use in an object recognition task, *Computer Vision and Image Understanding* 84 (1), 160-178, October 2001. <http://dx.doi.org/10.1006/cviu.2001.0932>

Kevin W. Bowyer, Christine Kranenburg, and Sean Dougherty. Edge detector evaluation using empirical ROC curves, *Computer Vision and Image Understanding* 84 (1), 77-103, October 2001. <http://dx.doi.org/10.1006/cviu.2001.0931>

Kevin W. Bowyer and Lawrence O. Hall. Reducing the effects of plagiarism in large programming classes, *Journal of Information Systems Education* 12 (3), Fall 2001. <http://jise.org/Volume12/pdf/141.pdf>

Mubarak Shah and Kevin W. Bowyer. Mentoring undergraduates in computer vision research, *IEEE Transactions on Education* 44 (3), 252-257, August 2001. <http://dx.doi.org/10.1109/13.940996>

Min C. Shin, Dmitry B. Goldgof, Kevin W. Bowyer, and Saavas Nikiforou. Comparison of edge detection algorithms using a structure from motion task, *IEEE Transactions on*

*Systems, Man, and Cybernetics - Part B* 31 (4), 589-601, August 2001.  
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Kevin W. Bowyer. Resources for teaching ethics and computing, *Journal of Information Systems Education* 11 (3-4), 91-92, Summer-Fall 2000.

Kevin W. Bowyer. Pornography on the dean's pc: an ethics and computing case study, *Journal of Information Systems Education* 11 (3-4), Summer-Fall 2000, 121-126.

Kevin W. Bowyer, George Stockman, and Louise Stark. Themes for improved teaching of image computation, *IEEE Transactions on Education* 43 (2), 221-223, May 2000.  
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Maha Y. Sallam, and Kevin W. Bowyer. Registration and difference analysis of corresponding mammogram images, *Medical Image Analysis* 3 (2), 103-118, 1999.  
[http://dx.doi.org/10.1016/S1361-8415\(99\)80001-2](http://dx.doi.org/10.1016/S1361-8415(99)80001-2)

Adam Hoover, Dmitry Goldgof, and Kevin W. Bowyer. Dynamic-scale model construction from range imagery, *IEEE Transactions on Pattern Analysis and Machine Intelligence* 29 (12), 1352-1357, December 1998. <http://dx.doi.org/10.1109/34.735808>

Melanie Sutton, Louise Stark, and Kevin W. Bowyer. Function from visual analysis and physical interaction: a methodology for recognition of generic classes of objects, *Image and Vision Computing Journal* 16 (11), 745-764, August 1998.  
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Adam Hoover, Dmitry Goldgof, and Kevin W. Bowyer. The space envelope: a representation for 3D scenes, *Computer Vision and Image Understanding* 69 (3), 310-329, March 1998. <http://dx.doi.org/10.1006/cviu.1998.0666>

Michael Heath, Sudeep Sarkar, Thomas Sanocki, and Kevin W. Bowyer. Comparison of edge detectors: a methodology and initial study, *Computer Vision and Image Understanding* 69 (1), 38-54, January 1998. <http://dx.doi.org/10.1006/cviu.1997.0587>

Thomas Sanocki, Kevin W. Bowyer, Michael Heath, and Sudeep Sarkar. Are edges sufficient for object recognition?, *Journal of Experimental Psychology: Human Perception and Performance* 24 (1), 340-349, January 1998.  
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Michael Heath, Sudeep Sarkar, Thomas Sanocki, and Kevin W. Bowyer. A robust visual method for assessing the relative performance of edge detection algorithms, *IEEE Transactions on Pattern Analysis and Machine Intelligence* 19 (12), 1338-1359, December 1997. <http://dx.doi.org/10.1109/34.643893>

Maha Y. Sallam, Kevin W. Bowyer and Kevin Woods, The digital database for screening mammography (DDSM): Lessons learned, *Radiology* 205 (supplement), 323-323 November 1997.

Kevin S. Woods, and Kevin W. Bowyer. Generating ROC curves for artificial neural networks, *IEEE Transactions on Medical Imaging*, 16 (3), 329-337, June 1997.  
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Kevin S. Woods, W. Philip Kegelmeyer, and Kevin W. Bowyer. Combination of multiple classifiers using local accuracy estimates, *IEEE Transactions on Pattern Analysis and Machine Intelligence*, 19 (4), 405-410, April 1997. <http://dx.doi.org/10.1109/34.588027>

Louise Stark, Kevin W. Bowyer, Adam W. Hoover, and Dmitry B. Goldgof. Recognizing object function through reasoning about partial shape descriptions and dynamic physical properties, *Proceedings of the IEEE* 84 (11), 1640-1656, November 1996. <http://dx.doi.org/10.1109/5.542413>

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Kevin Green, David Eggert, Louise Stark, and Kevin W. Bowyer. Generic recognition of articulated objects through reasoning about potential function, *Computer Vision and Image Understanding* 62 (2), 177-193, September 1995. <http://dx.doi.org/10.1006/cviu.1995.1049>

Adam W. Hoover, Dmitry B. Goldgof, and Kevin W. Bowyer. Extracting a valid boundary representation from a segmented range image, *IEEE Transactions on Pattern Analysis and Machine Intelligence* 17 (9), 920-924, September 1995. <http://dx.doi.org/10.1109/34.406660>

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Kevin W. Bowyer, Maha Y. Sallam, David Eggert, and John H. Stewman. Computing the generalized aspect graph for objects with moving parts, *IEEE Transactions on Pattern Analysis and Machine Intelligence* 15 (6), 605-610, June 1993. <http://dx.doi.org/10.1109/34.216731>

David Eggert and Kevin W. Bowyer. Computing the perspective projection aspect graph of solids of revolution, *IEEE Transactions on Pattern Analysis and Machine Intelligence* 15 (2), 109-128, February 1993. <http://dx.doi.org/10.1109/34.192483>

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Barry Bruno, Natalie Bennett, Kevin Bowyer, Dmitry Goldgof and Louise Stark. Modeling of Articulated Objects for Machine Perception, *Florida AI Research Symposium*, Palm Beach, Florida, 247-251, April 1992.

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David Eggert and Kevin W. Bowyer. Perspective projection aspect graphs of solids of revolution: an implementation, *Seventh Scandinavian Conference on Image Analysis*, Aalborg, Denmark (), 299-306 August 1991.

Bonnie J. Kaiser, Kevin W. Bowyer and Dmitry B. Goldgof. On exploring the definition of a range image aspect graph, *Seventh Scandinavian Conference on Image Analysis*, Aalborg, Denmark, 652-658, August 1991.

Olivier Faugeras, Joseph Mundy, Narendra Ahuja, Charles Dyer, Alex Pentland, Ramesh Jain, Katsu Ikeuchi and Kevin Bowyer. Panel theme: why aspect graphs are not (yet) practical for computer vision, *IEEE Workshop on Directions in Automated CAD-Based Vision*, Maui, Hawaii, 98-104, June 1991.

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Jon Altfeld, Judd Jones, and Kevin W. Bowyer. Comparing A\*/branch-and-bound parallel algorithms for use in path planning on an Intel hypercube, *Florida Artificial Intelligence Research Symposium*, Cocoa Beach, Florida, 111-115, April 1991.

Belinda Wilkins, Dmitry Goldgof and Kevin W. Bowyer. Toward computing the aspect graph of deformable generalized cylinders, *SPIE 1468: Applications of Artificial Intelligence IX*, Orlando, Florida, 662-673, April 1991.

Maha Y. Sallam, John H. Stewman and Kevin W. Bowyer. Computing the visual potential of an articulated assembly of parts, *International Conference on Computer Vision (ICCV '90)*, Osaka, Japan, 636-643, December 1990.

Louise Stark, Lawrence O. Hall, and Kevin W. Bowyer. An investigation of methods of combining functional evidence for 3-D object recognition, *SPIE 1381: Intelligent Robots and Computer Vision*, Boston, Massachusetts, November 1990.

Kevin W. Bowyer and Charles R. Dyer. Aspect graphs: an introduction and survey of recent results, *ISPRS Symposium: Close-Range Photogrammetry Meets Machine Vision*, Zurich, Switzerland, 200-208, September 1990.

Maha Y. Sallam and Kevin W. Bowyer. Representing the visual potential of a non-rigid assembly of parts, *ISPRS Symposium: Close-Range Photogrammetry Meets Machine Vision*, Zurich, Switzerland, 1150-1156, September 1990.

Louise Stark and Kevin W. Bowyer. Achieving generalized object recognition through reasoning about association of function to structure, *AAAI-90 Workshop on Qualitative Vision*, Boston, Massachusetts, 137-141, July 1990.

William L. Larsen, and Kevin W. Bowyer. Computing the Hough transform on a switch-based MIMD machine, *Third Conference on Recent Advances in Robotics*, Boca Raton, Florida, 275-294, June 1990.

Edward Wokabi, Dmitry B. Goldgof and Kevin W. Bowyer. Surface modeling for non-rigid motion analysis, *Florida AI Research Symposium*, Cocoa Beach, Florida, 10-12, April 1990.

Maha Sallam. and Kevin W. Bowyer. Representing the visual potential of a non-rigid assembly of rigid parts, *Florida AI Research Symposium*, Cocoa Beach, Florida, 70-74, April 1990.

Katrina Simpson and Kevin W. Bowyer. Using saccadic eye movements to create a 2.5-D sketch, *Florida AI Research Symposium*, Cocoa Beach, Florida, 65-69, April 1990.

Randy Bolling and Kevin W. Bowyer. Towards computing the aspect graph of constructive solid geometry objects, *Florida AI Research Symposium*, Cocoa Beach, Florida, 60-64, April 1990.

Louise Stark and Kevin W. Bowyer. Using functional features for 3-D object recognition, *SPIE Applications of Artificial Intelligence VIII*, Orlando, Florida, 212-223, April 1990.

David Eggert and Kevin W. Bowyer. Computing the orthographic projection aspect graph for solids of revolution, *IEEE Workshop on Interpretation of 3D Scenes*, Austin, Texas, 102-108, November 1989.

Louise Stark and Kevin W. Bowyer. Functional description as a knowledge representation of 3-D objects, *IASTED International Symposium on Expert Systems Theory and Applications*, Zurich, Switzerland, 49-54, June 1989.

Kevin W. Bowyer and John H. Stewman, Constructing the perspective projection aspect graph of general polyhedra defined using CAD models, *Sixth Scandinavian Conference on Image Analysis*, Oulu, Finland, 652-659, June 1989.

Kevin W. Bowyer, Judd Jones and Chris Lake. Computing the Hough transform on an MIMD hypercube architecture, *Sixth Scandinavian Conference on Image Analysis*, Oulu, Finland, 1172-1181, June 1989.

Kevin W. Bowyer, David Eggert, John Stewman, and Louise Stark. Developing the aspect graph representation for use in image understanding, *DARPA Image Understanding Workshop*, Palo Alto, California, 831-849, May 1989.

Louise Stark, David Eggert and Kevin W. Bowyer. Aspect graphs and non-linear optimization in 3-D object recognition, *International Conference on Computer Vision (ICCV '88)*, Tarpon Springs, Florida, 501-507, December 1988.

John Stewman and Kevin W. Bowyer. Creating the perspective projection aspect graph of polyhedral objects, *International Conference on Computer Vision (ICCV '88)*, Tarpon Springs, Florida, 494-500, December 1988.

Kevin W. Bowyer and John H. Stewman, Louise Stark and David Eggert. ERRORS-2: a 3-D object recognition system using aspect graphs, *International Conference on Pattern Recognition*, Rome, Italy, 6-10, November 1988.

Louise Stark and Kevin W. Bowyer. An aspect graph based control strategy for 3-D object recognition, *International Conference on Industrial & Engineering Applications of Artificial Intelligence and Expert Systems*, Tullahoma, Tennessee, 697-703, June 1988.

Kevin W. Bowyer and John Stewman. An aspect graph object representation for computer vision, *Florida AI Research Symposium*, Orlando, Florida, 41-45, May 1988.

David Eggert and Kevin W. Bowyer. Matching the complete edge structure of the 2-D projection of an object using Fourier descriptors, *Florida AI Research Symposium*, Orlando, Florida, 223-227, May 1988.

Louise Stark and Kevin W. Bowyer. Representation of 3-D objects using non-rigid connection of components, *SPIE 938: Digital and Optical Shape Representation and Pattern Recognition*, Orlando, Florida, 454-464, April 1988.

John Stewman and Kevin W. Bowyer. Aspect graphs for convex, planar-face objects, *IEEE Workshop on Computer Vision*, Miami, Florida, 123-130, November 1987.



John Stewman and Kevin W. Bowyer. Implementing viewing spheres: automatic construction of aspect graphs of planar-faced, convex objects, *SPIE 786: Applications of Artificial Intelligence V*, Orlando, Florida, 526-532, May 1987.

B. Pracht and Kevin W. Bowyer. Adaptations of run-length encoding for image data compression, *IEEE SouthEastCon*, Tampa, Florida, 6-10, April 1987.

Kevin W. Bowyer, Mel Ray and Carey Laxer. The Duke University computer kamp ("DUCK"), *14th Annual ACM Computer Science Education Conference*; also *ACM SIGCSE Bulletin*, 15, 1, 233-236, February 1983.

Kevin W. Bowyer, L.W. Hedlund, P. Vock, et al. Image analysis systems for CT tissue densitometry, *SPIE MED X*, New Orleans, Louisiana, May 1982.

Kevin W. Bowyer. Monte Carlo methods for pipeline/vector processors, *IEEE CompSac*, Chicago, Illinois, 126-131, November 1981.

Steve Port, Kevin W. Bowyer, F.R. Cobb, and Robert H. Jones. Age-related changes in the left ventricular response to exercise, *29th Annual Scientific Session*, American College of Cardiology, March 1980.

## **EXTERNAL FUNDING**

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Near Infrared and Visible Light Face Recognition, FBI Biometric Center of Excellence (WVURC 09-097U-UND), \$200,000, 16/July/2013 – 15/October/2014.

Indiana CTSI Predoctoral Trainee - Pruitt, NIH, \$28,348. 1/July/2012 – 30/June/2013. (with J. Diehl in Department of Psychology) Flows from NIH/NCATS- Indiana Clinical and Translational Sciences Institute – TL1 Program (A. Shekhar, PI), 5/01/08-04/30/13.

Quality Metrics for the Prediction of Face Recognition Performance, National Institute of Standards and Technology, \$100,000, 1/September/2012 – 5/April/2013. (with P. J. Flynn as co-p.i.)

Addressing Challenges to Robust Face Detection, Modeling, Tracking, and Recognition, Scitor Corporation, \$245,536, 1/Oct/2012 – 14/Sep/2013. (with P. J. Flynn as co-p.i.)

Face Recognition Platform Research and Development, Scitor Corporation, \$349,999, 15/July/2012 – 14/July/2013. (co-p.i. with P. J. Flynn)

BEST Data Collection, Validation and Research, IARPA / Department of the Army W911NF-10-2-0067, 1/June/2010 – 30/June/2012, \$2,593,101. (co-p.i. with P. J. Flynn)

Mitigation of Contact Lenses, Eye Surgery, Pupil Dilation, and Other Challenges in Iris Recognition, Progeny Systems, 15/May/2011 - 30/November/2011, \$33,000. (co-p.i. with P. J. Flynn)

Multispectral, Multimodal and Multiresolution Human Identification Using Periocular Biometrics, IC Postdoctoral Research Fellowship Program, 15/July/2010 – 14/July/2012, \$240,000. (co-p.i. with P. J. Flynn)

GAANN Fellowships in Computer Science and Engineering at the University of Notre Dame, Department of Education #P200A090044, 15/August/2009 – 30/June/2012, \$653,280.

Multiple Biometric Grand Challenge design, data collection, and support, IARPA / Department of Army W91CRB-08-C-0093, 9/September/2008 – 31/August/2010, \$984,599.61. (co-p.i. with P. J. Flynn)

Multi-biometric ear + face recognition from video, Lockheed Martin Corporation, 01/January/2009 – 31/December/2009, \$80,000.

Automated entity classification in video using soft biometrics, Progeny Systems, 16/Jun3/2008 - 1/December/2008, \$20,000.

Instrumentation for multi-dimensional imaging and applications, National Science Foundation CNS 01-30839, 1/October/2001 - 30/September/2008, \$1,960,408. (co-p.i. with P. J. Flynn)

AVATAR – parallel decision trees for visualization, Sandia National Labs, 18/November/1997 - 30/September/2008, \$1,568,000. (co-p.i. with L. O. Hall at USF)

Toward multi-modal face + ear “drive-by ID,” Unisys DCA 200-02-D-5014, 16/September /2007 - 15/September/2008, \$90,000. (co-p.i. with P. J. Flynn)

Face recognition from video, Department of Justice 2006-IJ-CX-K041, 01/August/2006 – 31/July/2008, \$362,476. (co-p.i. with P. J. Flynn and N. Chawla).

Development of ear biometrics: 2D, 3D and morphable models 2D / 3D, Unisys DCA 200-02-D-5014, 1/Nov /2005 - 31/October/2006, \$100,000. (co-p.i. with P. J. Flynn)

Advanced open image and video pre-processing platform for face imagery, Unisys DCA 200-02-D-5014, 1/Nov /2005 - 31/October/2006, \$100,000. (co-p.i. with P. J. Flynn)

Characterizing 3D face data, sensors, and collection procedures, Unisys DCA 200-02-D-5014, 1/Nov /2005 - 31/October/2006, \$50,000. (co-p.i. with Patrick J. Flynn)

Improving the ease of use of iris recognition systems: advanced open iris biometrics, National Geospatial Intelligence Agency, 1/August/2004 – 31/July/2006, \$240,000. (co-p.i. with P. J. Flynn)

Center for advanced biometrics research and evaluation, Department of Justice 2004-DD-BX-1224, 01/October/2003 – 30/September/05, \$296,843; 2005-DD-CX-K078, 01/May/2005 – 30/April/08, \$246,661. (co-p.i. with P. J. Flynn at Notre Dame and D. Samaras at SUNY - Stony Brook).

Multi-source image correlation and analysis, Department of the Air Force, 29/April/2004 – 31/May/2005, \$75,000. (co-pi with R. L. Stevenson and P. J. Flynn)

Data sets, baseline performance reference points, and evaluation metrics for Human ID, Office of Naval Research (DARPA) N000140210410, 15/March/2002 - 14/March/2004, \$1,095,116. (co-pi with P. J. Flynn).

Data sets, baseline performance reference points, and evaluation metrics for Human ID, Air Force Office of Scientific Research (DARPA) F49620-00-1-0388, 30/September/2000 - 31/July/2002, \$465,936.

Experimental performance characterization of edge detection in computer vision, National Science Foundation IIS 9731821, 15/May/1998 - 14/May/2001, \$236,899.

Workshop on undergraduate education and image computation, National Science Foundation EIA 9988400, 1/June/2000 - 31/May/2001, \$32,767. (co-p.i. with L. Stark at University of the Pacific).

Support for mammography CAD performance analysis, U.S. Army Medical Research and Materiel Command DAMD17-00-P-0510, 1/May/00 - 30/December/00, \$12,000.

Human ID experimental methods and baselining effort, Battelle 00-058 (DARPA), 1/May/00 - 31/October/00, \$75,507.

Enhancing undergraduate computer science curriculum through image computations - proof of concept, National Science Foundation, 1/January/00 - 31/December/00, \$75,204. (co-p.i. with S. Sarkar and D. Goldgof at USF).

Undergraduate Faculty Enhancement: workshops on teaching ethics and computing, National Science Foundation DUE 9752792, 1/January/1998 - 31/December/1999, \$81,834.

Digital image database, with gold standard and performance metrics, for mammographic image analysis research, U.S. Army Medical Research and Materiel Command DAMD17-94-J-4015, 1/July/1994 - 31/July/1998, \$1,186,117. (co-p.i. with D. Kopans at Massachusetts General Hospital and W. P. Kegelmeyer at Sandia National Laboratories).

Acquisition of a compute server for image analysis research that emphasizes empirical performance characterization, National Science Foundation EIA 9729904, 1/January/1998 - 31/December/1998, \$59,232. (co-p.i. with D. Goldgof, S. Sarkar and L. Hall at USF).

Acquisition of a Cyberware 3D scanner to facilitate state of the art research in computer vision and graphics, National Science Foundation CDA 9724422, 15/August/1997 to 31/July/1998, \$115,000. (co-p.i. with S. Sarkar, D. Goldgof and L. Piegl at USF).

Workshop on undergraduate education and computer vision, National Science Foundation CDA 9712195, 1/May/1997 - 30/April/1998, \$22,767. (co-p.i. with L. Stark at University of the Pacific).

Research experiences for undergraduates in computer vision, National Science Foundation CDA 9424214, 1/June/1995 - 31/March/1999, \$174,000. (co-p.i. with Mubarak Shah and Neils Lobo at University of Central Florida and Louise Stark at University of the Pacific).

Florida space grant fellowship program, Florida Space Grant Consortium, 1/August/1996 - 31/July/1999, \$24,000. (subcontract under National Aeronautics and Space Administration NGT-40015).

Development of function-based modeling for generic object recognition, Air Force Office of Scientific Research F49620-92-J-0223, 15/May/1992 - 14/April/1995, \$309,470. (co-p.i. with L. Stark at University of the Pacific).

Time course of object recognition, National Science Foundation DBS 9213246, 15/August/1992 - 31/July/1995, \$207,886. (co-p.i. with T. Sanocki at University of South Florida).

Research experiences for undergraduates in computer vision, National Science Foundation CDA-92 00369, 1/June/1992 - 31/May/1994, \$156,700. (co-p.i. with M. Shah at University of Central Florida).

Florida space grant fellowship program, Florida Space Grant Consortium, 1/August/1992 - 31/July/1995, \$36,000. (subcontract under National Aeronautics and Space Administration NGT-40015).

Undergraduate student researchers program (under-represented minority focus), National Aeronautics and Space Administration NGT-90048 / NGT-90103, 1/September/1991 - 14/August/1995, \$60,484. (co-p.i. with J. O'Shields at University of South Florida).

Development of function-based modeling for generic object recognition, National Science Foundation IRI 9120895, 1/September/1991 - 31/August/1993, \$50,000. (co-p.i. with L. Stark at University of South Florida).

Computer assisted diagnosis in digital mammography, H. Lee Moffitt Cancer Center and Research Institute, 1/June/1992 - 30/May/1993, \$29,652. (co-p.i. with L. Clarke and R. Clark at University of South Florida).

Research in artificial intelligence at Aalborg University, American-Scandinavian Foundation, July/August 1991, \$2,000.

Development of the aspect graph representation for use in robot vision, Air Force Office of Scientific Research AFOSR-89-0036, 1/Nov./1988 - 31/Oct./1991, \$139,480; National Science Foundation IRI-88-17776, 1/Feb./1989 - 31/July/1991, \$74,458. (combined support from the two agencies)

Research experiences for undergraduates in computer vision, National Science Foundation CDA 91-00898, 1/June/1991 - 31/May/1992, \$62,500; National Science Foundation CDA-90-00802, 1/June/1990 - 31/May/1991, \$83,243; National Science Foundation IRI-89-00798, 1/May/1989 - 31/March/1990, \$56,243. (co-p.i. with M. Shah at UCF and G. Krishnan at Stetson University).

CISE research instrumentation: MIMD hypercube, National Science Foundation CDA 89-20890, 1/April/1990 - 31/March/1992, \$104,450. (co-p.i. with L. Hall at University of South Florida).

Development of CAD-based 3-D object recognition, Florida High Technology and Industry Council, 1/January/1990 - 31/December/1991, \$108,000. (co-p.i. with M. Shah at University of Central Florida).

A "form and function" representation for reasoning about classes of objects, UES/AFOSR Grant S-760-00MG-003, 15/December/1987 - 14/December/1988, \$19,945.

A viewing spheres approach to a robotic vision system, Air Force Office of Scientific Research AFOSR-87-0316, 15/July/1987 - 14/July/1988, \$49,871.

ISDN application prototyping, GTE Data Services (Tampa), 1/November/1986 - 30/April/1989, \$46,000.

Automatic determination of 3-D objects appearing in images, UES/AFOSR Grant S-760-00MG-001, 1/October/1985 - 30/September/1986, \$19,750.



## **PH.D. GRADUATES**

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**Jeremiah Barr**, Gallery-Free Methods for Detecting People and Groups of interest “In the Wild”, 2014 (expected), Noblis. (ND)

**Jay Doyle**, Improvements to the iris biometrics pipeline, 2014 (expected), MITRE Corporation. (ND)

**Jim Thomas**, Computer vision techniques for damage assessment from high-resolution remote sensing imagery, 2012, Amazon, Seattle. (ND)

**Ryan Connaughton**, Fusion of face and iris biometrics using a stand-off video sensor, 2011, Software Engineer, Medstrat Inc, Chicago, Illinois. (ND)

**Karen Hollingsworth**, Increased use of available image data decreases errors in iris biometrics, 2010. (ND)

**Deborah Thomas**, Face recognition from surveillance-quality video, 2010, Assistant Professor, Bethel University, St. Paul, Minnesota. (ND)

**Christopher Middendorff**, Hard and soft biometrics systems, 2009, Amazon, Seattle. (ND)

**Timothy Faltemier**, Improved 3D face recognition, 2007, Senior Systems Engineer, Progeny Systems, Virginia. (ND)

**Xiaomei Liu**, Optimizations in iris recognition, 2006, Senior Software Engineer, EMC Corporation, Boston. (ND)

**Ping Yan**, Ear biometrics in human identification, 2006, Staff Scientist, Fred Hutchinson Cancer Research Center, Seattle. (ND)

**Xin Chen**, Modeling the human face through multiple view three-dimensional stereopsis: A survey and comparative analysis of facial recognition over multiple modalities, 2006, Software Engineer, Technology and Development Department, Navteq Corporation, Chicago. (ND)

**Kyong Chang**, New multi-biometrics approaches for improved person identification, 2004, Principal Engineer, Philips Medical Systems, Bothell, Washington. (ND)

**Jaesik Min**, Improved range image segmentation through feedback from empirical performance evaluation, 2002, Korea IT Industry Promotion Agency. (USF)

**Michael Heath**, Dual projection computer-aided detection for mammography, 2000, Senior Development Engineer. Kodak Corporation, Rochester, New York. (USF)

**Melanie A. Sutton**, Object recognition through reasoning about functionality with visual sensing and robotic manipulation, 1997, Associate Professor, Department of Biology, Co-Director, Medical Informatics Program, University of West Florida. (USF)

**Maha Y. Sallam**, Image unwarping and difference analysis: a technique for detecting abnormalities in mammograms, 1997, Executive Vice President, iCAD Inc. (www.icadmed.com, NASDAQ symbol "ICAD").(USF)

**Adam W. Hoover**, The space envelope representation of 3-D scenes, 1996, Associate Professor, Department of Electrical and Computer Engineering, Clemson University. (USF)

**Kevin K. Green**, Generic recognition of articulated objects through reasoning about potential function, 1996, Aerospace Corporation, Chantilly, Virginia. (USF)

**Kevin S. Woods**, Automated Image Analysis Techniques for Digital Mammography, 1994, Vice President, iCAD Inc. ([www.icadmed.com](http://www.icadmed.com), NASDAQ symbol "ICAD").(USF)

**David W. Eggert**, Aspect graphs of solids of revolution (winner of Outstanding Doctoral Student Award from USF Sigma Xi Chapter), 1991, Associate Professor, Department of Computer Science, University of New Haven. (USF)

**John H. Stewman**, Viewer-centered representations for polyhedral objects, 1991, independent consultant. (USF)

**Louise Stark**, Achieving generalized object recognition through reasoning about association of function to structure, 1990, Professor and Associate Dean, Department of Electrical and Computer Engineering, University of the Pacific, Stockton, California. (USF)